DETAILED ACTION

Claim Status

1. Claims 2, 3, 7-9, and 14-18 are canceled. Claims 1, 4-6, 10-13, and 19 are pending and examined on the merits.

Specification

2. The amendment filed 8-22-11 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows:

3. The amended specification is replete with new matter. The portions indicated below are considered new matter in the specification. Page, paragraphs, and line numbers used are based on applicant’s page numbering in the marked-up copy of the specification provided 8-22-11.

4. In page 1, paragraph 2, "practical usages"

5. In page 2, bridging paragraph from page 1, "generated depending on the phenomenon of boiling at the low pressure region in the ultrasonic fields, the bubbles contain moisture (steam) as the main interior gas"

6. In page 2, bridging paragraph from page 1, “because the bubbles containing condensable gas (moisture) collapse violently at the high-pressure region in the ultrasonic fields.”

7. In page 6, the first paragraph of the detailed description, "one of the most important"

8. In page 6, the first paragraph of the detailed description, “There is no relationship recognized between the magnitude of the potential and the bubble diameter.”

9. In page 7, second paragraph, line 4, “ability”.

10. In page 7, second paragraph, line 6, “directly”

11. In page 7 second paragraph, line 9, "gas dissolution ability"

12. In page 7, second paragraph, lines 12-13, “change of microbubble diameter as a function of time."

13. In page 7, second paragraph, line 15, “exhibits rapid natural dissolution and has"

14. In page 7, second paragraph, lines 20-21, “increase in pressure of the interior gas from ambient”

15. In page 8, first paragraph, line 2, “difference between surrounding water and the interior gas”

16. In page 8, first paragraph, line 5, “difference”

17. In page 8, second paragraph, line 2 “can be accelerated.”

18. In page 8, second paragraph, lines 6-7, “decreases in size with adiabatic compression.”

19. In page 9, bridging paragraph from page 8, lines 7 and 8, "This type of electrical charge is “

20. In page 9, bridging paragraph from page 8, line 15, “by the adsorption of the ions”

21. In page 9, bridging paragraph from page 8, line 16, “at the interface”

22. In page 9, second paragraph, lines 1 and 2 “the natural dissolution of the interior gas leads to the decrease in”

23. In page 9, second paragraph, line 9 “is not so high”

24. In page 9, second paragraph, lines 14-16 “less and the decreasing speed of the surface area has become much higher (see Figure 3), it is difficult for the gas-water interface to maintain the”

25. In pages 9 and 10, bridging paragraph, lines 18-20, “in the case of the microbubbles under natural conditions, the decreasing speed of the surface area is not so high”

26. In page 10, first full paragraph, lines 2 and 3 “discloses the method to accelerate the decreasing speed.

27. In page 10, first full paragraph, line 5 “at the shrinking interface and the zeta potential"

28. In page 10 second paragraph, line 5 “of the charge”

29. In page 12, first full paragraph, line 1 “electric discharge is generated in the"

30. In page 12, first full paragraph, line 5 “of the saturated condition of microbubbles”

31. In page 12, first full paragraph, line 9 “accelerates the decreasing speed"

32. In page 12, second paragraph, lines 7 and 8 “a superior achievement in decomposition of"

33. In page 17, bridging paragraph from page 16, lines 5 and 6 “may lead to the generation of insufficient”

34. In page 19, first paragraph under examples, lines 7 and 8 “container 1 was controlled to 50% or more of the saturation”

35. In page 20, bridging paragraph from page 19, lines 6 and 7 “container 1 was controlled to 50% or more of the saturation”

36. In page 20, first paragraph under example 3, lines 7 and 8 “container 1 was controlled to 50% or more of the saturation”

37. In page 21, first paragraph under example 4, lines 7 and 8 “container 1 was controlled to 50% or more of the saturation”

38. In page 22, first paragraph under example 5, lines 7 and 8 “container 1 was controlled to 50% or more of the saturation”

Applicant is required to cancel the new matter in the reply to this Office Action.

The examiner recommends that applicant consider filing a continuation-in-part application, since the extensive revisions are not supported by the originally filed disclosure.

Claim Rejections - 35 USC § 103

39. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

40. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

41. Claims 1, 4-6, 10-13, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,221,260 to Chahine et al. (“Chahine”) in view of “Effect of Shrinking Microbubble on Gas Hydrate Formation,” Takahashi et al. (“Takahashi”).

42. As to claim 1, Chahine teaches a method for collapsing microbubbles **(See abstract and see col. 1 line 51, microbubbles are contemplated)**, the microbubbles having a diameter, the method comprising accelerating the speed of the microbubble size decrease and disappearance by applying a stimulation to the microbubbles **(See col. 13 lines 22-30, the jet is directed towards a wall which initates the collapse of the cavitation bubble)**, wherein a great amount of free radical species are released from a gas-liquid interface **(See col. 5 lines 25-40, the collapsing microscopic bubble creates hydroxyl radicals in the liquid in the region of the collapse; and see col. 6 lines 50-52, increasing the overall cavity surface area in contact with water increases the probability that hydroxyls will be close enough to contaminants to react, which means that the hydroxyls will be released at the interface)** by increasing a charge density at the gas-liquid interface of the microbubbles **(See col. 6 lines 1-10, electric discharges are contemplated on collapse, and an electric discharge requires an increase in charge density prior to the discharge)**.

43. Chahine is different from claim 1 in that Chahine does not mention that the bubbles have a diameter of less than 50µm and that when they float in the solution they decrease gradually in size. Takahashi teaches the creation of microbubbles using a swirling fluid microbubble generator to produce microbubbles with a diameter distribution which includes microbubbles having a diameter of 50µm or less **(See Takahashi Figs. 1-3, and see page 2172, left column)**. Takahashi explains that bubbles of this size will naturally shrink while the amount of dissolved gas around the bubble increases **(See Takahashi page 2173)**. Furthermore, Takahashi explains that the pressure inside the bubble is inversely proportional to the radius of the bubble **(See Takahashi page 2173)**. Moreover, Takehashi contemplates that smaller bubbles will have higher surface areas **(See Takahashi page 2171)**, and Chahine contemplates that the surface area of the cavities is an important factor in determining the production of hydroxyl radicals, and decontamination efficiency of the cavities **(See Chahine col. 6 lines 45-55)**. A person having ordinary skill in the art would have recognized the usefulness of producing small bubbles, below 50µm in order to produce a more energetic collapse. Therefore, it would have been obvious to a person having ordinary skill in the art at the time of invention to operate Chahine to produce microbubbles having a diameter of 50µm or less, as the swirling jet is capable of producing bubbles of that size, and in order to produce higher pressures within the bubble which produces a more energetic collapse, as well as to maintain a large surface area-to-volume ratios for the cavities, thereby increasing the decontamination efficiency.

44. As to claim 4, Chahine and Takahashi teach the method of claim 1, and Chahine contemplates the creation of hydroxyl radical, which constitutes an active oxygen species, which are used for decontamination **(See Chahine col. 1 lines 45-58)**, The high energy collapse of the bubble occurs due to stimulation caused by a pressure change due to the wall **(See col. 13 lines 22-30; and see also lines 30-42)**.

45. As to claim 5, Chahine and Takahashi teach the method of claim 1, and Chahine teaches using cavitation to eliminate organic and other contaminants from the liquids **(See Chahine col. 6 lines 1-10).**

46. As to claim 6, Chahine and Takahashi teach the method of claim 1, and Chahine contemplates using cavitation to treat microorganisms **(See Chahine col. 15 lines 1-15)**.

47. As to claim 10, Chahine and Takahasi teach the method of claim 1, and Chahine contemplates producing cavitation within a nozzle chamber, and then expelling the cavitation pockets out of the nozzle chamber in an annulus of axially flowing liquid **(See e.g. Fig. 5 and col. 12 lines 30-45)**. Chahine goes on to explain that the cavitation nozzles are placed within a cavitation chamber which is connected to a recirculation pipe and pump **(See Figs. 8 and 9 and col. 13 line 56 -- col. 14 line 40)**. Chahine further provides plates, or walls, for causing the collapse of the bubbles **(Chahine col. 13 lines 35-40)**, and further specifies that the plates or walls contain orifices **(See Chahine col. 13 lines 40-42)**. But, Chahine does not specifically mention having the plate w/ orifices installed in the circulation pipe. Nonetheless, Chahine explains that when the swirling vortex with cavitation pockets is sheathed in an annulus of axially

flowing liquid, that placement of the collapse inducing surface can be placed farther away from the nozzle outlet in order to extend the time in which cavitation is present while still advantageously causing violent collapse of the cavitation pockets **(See Chahine col. 13 lines 50-56)**. Therefore, it would have been obvious to a person having ordinary skill in the art at the time of invention to place the collapse inducing surface in the recirculation pipe downstream of the nozzle exit in order to increase the time in which cavitation is present, while still producing violent bubble collapse.

48. As to claim 11, Chahine and Takahashi teach the method of claim 10, and Chahine contemplates pressurizing the system to 60 psi **(Chahine col. 14 lines 35-37)**, which constitutes a pressure of 0.41 MPa.

49. As to claim 12, Chahine and Takahashi teach the method of claim 10, and Chahine teaches that the system is operable at atmospheric pressures **(See Chahine col. 14 lines 30-35)**. Therefore, in order to draw liquid in the negative pressure at the intake side of the pump would be less than the atmospheric pressure.

50. As to claim 13, Chahine and Takahasi teach the method of claim 1, and Chahine contemplates producing cavitation within a nozzle chamber, and then expelling the cavitation pockets out of the nozzle chamber in an annulus of axially flowing liquid **(See e.g. Fig. 5 and col. 12 lines 30-45)**. Chahine goes on to explain that the cavitation nozzles are placed within a cavitation chamber which is connected to a recirculation pipe, which has a pump **(See Figs. 8 and 9 and col. 13 line 56 -- col. 14 line 40)**. Chahine further provides plates, or walls, for causing the collapse of the bubbles **(Chahine col. 13 lines 35-40)**, and further specifies that the plates or walls contain

orifices **(See Chahine col. 13 lines 40-42)**. But, Chahine does not specifically mention having the plate w/ orifices installed in the circulation pipe. Nonetheless, Chahine explains that when the swirling vortex with cavitation pockets is sheathed in an annulus of axially flowing liquid, that placement of the collapse inducing surface can be placed farther away from the nozzle outlet in order to extend the time in which cavitation is present while still advantageously causing violent collapse of the cavitation pockets **(See Chahine col. 13 lines 50-56)**. Therefore, it would have been obvious to a person having ordinary skill in the art at the time of invention to place the collapse-inducing surface in the recirculation pipe downstream of the nozzle exit in order to increase the time in which cavitation is present, while still producing violent bubble collapse.

51. As to claim 19, Chahine and Takahashi teach the method of claim 1, and Chahine contemplates using ozone **(See col. 15 lines 55-60)**.

Response to Arguments

52. Applicant's arguments filed 8-22-11 have been fully considered but they are not persuasive.

53. Applicant argues that claim 1 recites microbubbles decreasing gradually in size by natural dissolution of a gas contained in the microbubbles. Applicant argues that the purpose of adding the gas in Chahine is to increase the number of cavitation bubbles. Applicant then alleges that generating cavitation bubbles in the liquid for a long period of time decreases the amount of solution gas in the liquid. Applicant then argues that one the other hand claim 1 is directed to the application of a stimulation to a microbubble that contains gas, not the cavitiation of a liquid in which a gas is dissolved. In

response, Chahine teaches a method for collapsing microbubbles **(See abstract and see col. 1 line 51, microbubbles are contemplated)**, the microbubbles having a diameter, the method comprising accelerating the speed of the microbubble size decrease and disappearance by applying a stimulation to the microbubbles **(See col. 13 lines 22-30, the jet is directed towards a wall which initates the collapse of the cavitation bubble)**. Chahine further contemplates adding various gasses, for example ozone, to the liquid prior to cavitation, in order to enhance the oxidation efficiency of the cavitiation **(See col. 15 lines 50-55)**. Adding ozone and then creating cavitated bubbles from the liquid will cause some of the ozone to be present in the bubbles.

54. Applicant argues that the release of the radical species is different in Chahine than as claimed. Applicant argues that Chahine the electric discharge is generated at the bubble collapse, whereas claim 1 recites that the increase in charge density is at the gas-liquid interface of the microbubbles. In response, claim 1 contemplates applying a stimulation to accelerate the decrease in size and disappearance. This is seen as being a collapse. Although Chahine does not mention that the free radical species are released from the gas-liquid interface, *per se*, this within the teaching of Chahine since the radicals produced are related to the surface areas of the cavities **(See Chahine col. 6 lines 45-50)**. Since as the surface area goes up so does the decontaminating efficiency and the ability to bring contaminants to be oxidized into proximity with the radicals produced. Moreover, the bubble collapse is the same method by which applicant produces the free radical species **(See e.g. instant claim 4)**.

55. Applicant then argues that it would not have been obvious to combine the teachings of Chahine and Takahashi because Chahine relates to cavitation bubbles, which applicant argues are commonly generated by irradiating an ultrasonic wave in water and causing a strong water flow. Applicant appears to argue that the instant bubbles are generated by feeding gas into water. In response, Chahine does not teach the use of an ultrasonic wave generator for the creation of the bubbles, instead Chahine teaches using a swirling jet bubble generator **(See e.g. col. 3 lines 58-68)**. And, Takahashi is likewise directed to a swirling bubble generator **(See Takahashi in Fig. 1 and see page 2172 left column)**. Accordingly Chahine and Takahashi are seen as analogous art since both discuss swirling bubble generators. Moreover, Takahashi teaches the creation of microbubbles using a swirling fluid microbubble generator to produce microbubbles with a diameter distribution which includes microbubbles having a diameter of 50μm or less **(See Takahashi Figs. 1-3, and see page 2172, left column)**. Takahashi explains that bubbles of this size will naturally shrink while the amount of dissolved gas around the bubble increases **(See Takahashi page 2173)**. Furthermore, Takahashi explains that the pressure inside the bubble is inversely proportional to the radius of the bubble **(See Takahashi page 2173)**. Moreover, Takehashi contemplates that smaller bubbles will have higher surface areas **(See Takahashi page 2171)**, and Chahine contemplates that the surface area of the cavities is an important factor in determining the production of hydroxyl radicals, and decontamination efficiency of the cavities **(See Chahine col. 6 lines 45-55)**. A person having ordinary skill in the art would have recognized the usefulness of producing small

bubbles, below 50μm in order to produce a more energetic collapse. Therefore, it would have been obvious to a person having ordinary skill in the art at the time of invention to operate Chahine to produce microbubbles having a diameter of 50μm or less, as the swirling jet is capable of producing bubbles of that size, and in order to produce higher pressures within the bubble which produces a more energetic collapse, as well as to maintain a large surface area-to-volume ratios for the cavities, thereby increasing the decontamination efficiency. Furthermore, applicant's argument that the instant microbubbles are formed by feeding the gas into the water are moot, since these limitations are not claimed; nevertheless, Chahine contemplates feeding gas into water just prior to the bubble production **(See Chahine col. 15 lines 50-60)**.

56. Applicants arguments directed to claims 4-6, 10-13 and 19 are based on the arguments put forth regarding claim 1, and these arguments are not found persuasive as discussed above.

Conclusion

57. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LUCAS STELLING whose telephone number is (571)270-3725. The examiner can normally be reached on Monday through Friday 9:00AM to 5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Las 10-18-11

/Nam X Nguyen/
Supervisory Patent Examiner, Art Unit 1778